

**1st Half
of 2016**

DEUTSCHE
WINDGUARD

STATUS OF LAND-BASED WIND ENERGY DEVELOPMENT IN GERMANY

On behalf of:



STATUS OF LAND-BASED WIND ENERGY DEVELOPMENT

This factsheet describes the status of land-based wind energy development in Germany. Aside from new construction during the course of the first half of 2016 and the cumulative turbine portfolio as of 30 June 2016, the turbine configuration and the regional distribution are presented below.

NET AND GROSS ADDITION

The net addition to land-based wind energy in Germany during the first half of 2016 came to 1 892 MW, respectively 579 wind turbine generators (WTG). The net addition results from the gross addition of 726 WTG with a capacity of 2 053 MW and the dismantling of 147 WTG with a capacity of 161 MW. Contained in the gross addition are 106 re-powering WTG with a cumulative capacity of 308 MW. The numbers with regard to the status of land-based wind energy development are shown in Table 1.

Table 1: Status of land-based wind energy development (30 June 2016)

	Status of land-based wind energy development	Capacity [MW]	Number of WTG
Development 1 st half 2016	Net addition during first Half of 2016	1 892.20	579
	Gross addition during first Half of 2016	2 053.40	726
	Repowering share	308.20	106
	Dismantling in first half of 2016 (incl. subsequent registration)	161.21	147
Cumulative 30 June 2016	Cumulative WTG portfolio Status: 30 June 2016	43 543.70	26 561

Compared to the first six months of 2015, there was a 64% increase in WTG erected. This is equivalent to a 73% increase of the newly installed capacity. Also, the gross addition with regard to the number of WTG of the first half of the record year 2014 was exceeded by 11% (19% with regard to the capacity). Cause of the significant increase in additions in the first half 2016 compared to previous years is the shift from lowering the remuneration at the end of the year to a quarterly degression. This perpetuates the addition over the year. The development over time is depicted in Figure 1.

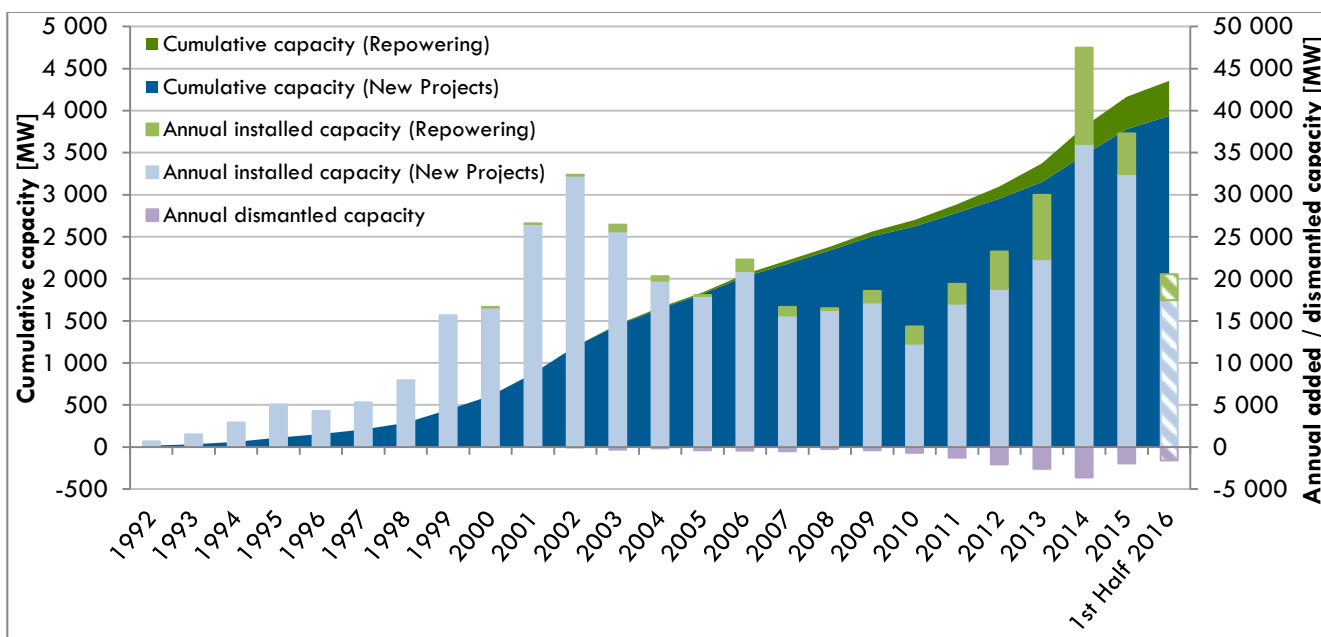


Figure 1: Development of the annual installed and cumulative capacity (MW) of land-based wind energy in Germany incl. repowering and dismantling. Status: 30 June 2016

The data since the end of 2012 were determined by inquiries with industry stakeholders as well as other research.

Datengrundlage 1992 – 2011: DEWI

DISMANTLING

147 WEA with a capacity of 161 MW were identified as dismantled in the first half of 2016. Included in that number is a reconciliation of WTG taken out of service as published in the turbine register, as well as recognizing subsequent notifications from the previous year. The number of dismantled WTG is thus 7% below the value identified for the first half of 2015. However, the capacity of WTG's dismantled in the first six months of 2016 exceeds the capacity dismantled during the same time frame in 2015 by 75%. The average capacity of WTG dismantled between January and June 2016 amounts to 1 097 kW and is thus 143% higher than the average capacity of a WTG dismantled in the first half of 2015.

Old WTG get dismantled once they can no longer be operated economically profitable, the state of their technology does not allow for continued operation or the pressure to free up land occupied by the WTG is very high. All currently operating WTG receive at least the base remuneration as WTG installed prior to the first half of 2000 were guaranteed to be eligible for this remuneration until 2020 with the going-into-effect of the Renewable Energy Sources Act (EEG) 2000. An increase in dismantling of WTG can be expected from 2021 onwards.

REPOWERING

In the framework of the statistical data collection for 2016, 106 WTG of the 726 WTG erected during the first half of 2016 were identified as repowering turbines. With a total capacity of 308 MW, this is equivalent to a repowering share of about 15% of the gross capacity addition for the first six months of this year. The repowering WTG possess an average capacity of 2 908 kW.

The definition of repowering WTG's is not clear in Germany. Prior to the 2014 amendment, each WTG that replaced at least one old WTG in the same or an adjacent county received the repowering bonus and was thus identified as a repowering WTG. Without this bonus, the interpretation of the term changes to a new, modern WTG replacing an old one with direct spatial reference. Hence, WTG will no longer be classified and thus captured as repowering projects, if old ones in an adjacent county not connected to the new project are dismantled.

CUMULATIVE PORTFOLIO AND TURBINE REGISTER

Taking into consideration the net additions of the first half of 2016, at the end of June 2016 a total of 26.561 WTG with a cumulative capacity of 43.544 MW were installed in Germany. Hence, the cumulative capacity increased by 5% in the first six months of the year. It should be noted that the cumulative values in particular are non-binding and that they were most likely overestimated due to the underestimation of dismantling during previous years. With the 2014 amendment to the EEG, a central register for renewable energy plants was established. Through mandatory reporting by WTG operators, WTG additions, repowering and dismantling are captured by it. The register provides for more reliable and comprehensive data about repowering and dismantling from August 2014 onward. WTG that were dismantled prior to the EEG 2014 are not captured retroactively. Furthermore, it must be noted that in the register the "commissioning" of WTG is used as the allocation criteria for a particular first half of a year. In comparison, the development statistic at hand captures the "erection" of WTG. Since a certain amount of time passes between the erection and the commissioning of WTG, the capture of part of the WTG into the WTG register ends up getting pushed into the following half of the year.

AVERAGE TURBINE GENERATOR CONFIGURATION

On average, a WTG erected in Germany in the first half of 2016 had a nominal capacity of 2 828 kW. In comparison to the average capacity of installations in the previous year, this equated to an increase of about 4%. The average rotor diameter of WTG's erected in the first half of 2016 also increased by about 4% to 109 meters compared to 2015. The average hub height of WTG's erected

Table 2: Average turbine configuration of WTG installed in first half 2016, Status: 30 June 2016

Average land-based WTG configuration, installed in 1 st half 2016		
1 st half 2016	Average turbine capacity	2 828 kW
	Average rotor diameter	109 m
	Average hub height	129 m
	Average specific area capacity	313 W/m ²

in the first half of 2016 grew by about 5% to 129 m. With an average specific area capacity of 313 W/m², the trend to WTG with a large rotor area compared to their nameplate capacity is slowing. In comparison to the previous year, the specific area capacity decreased by 4%. The numbers pertaining to the average WTG configuration are shown in Table 2.

The increase of the average nominal capacity of WTG erected annually over time is depicted in Figure 2. Also shown is how the mean WTG capacity developed relative to the total number of WTG in Germany. At the end of June 2016, the average capacity of WTG in the cumulative portfolio came to about 1 639 kW. In comparison to the previous year, this corresponds to a 2% increase in average capacity.

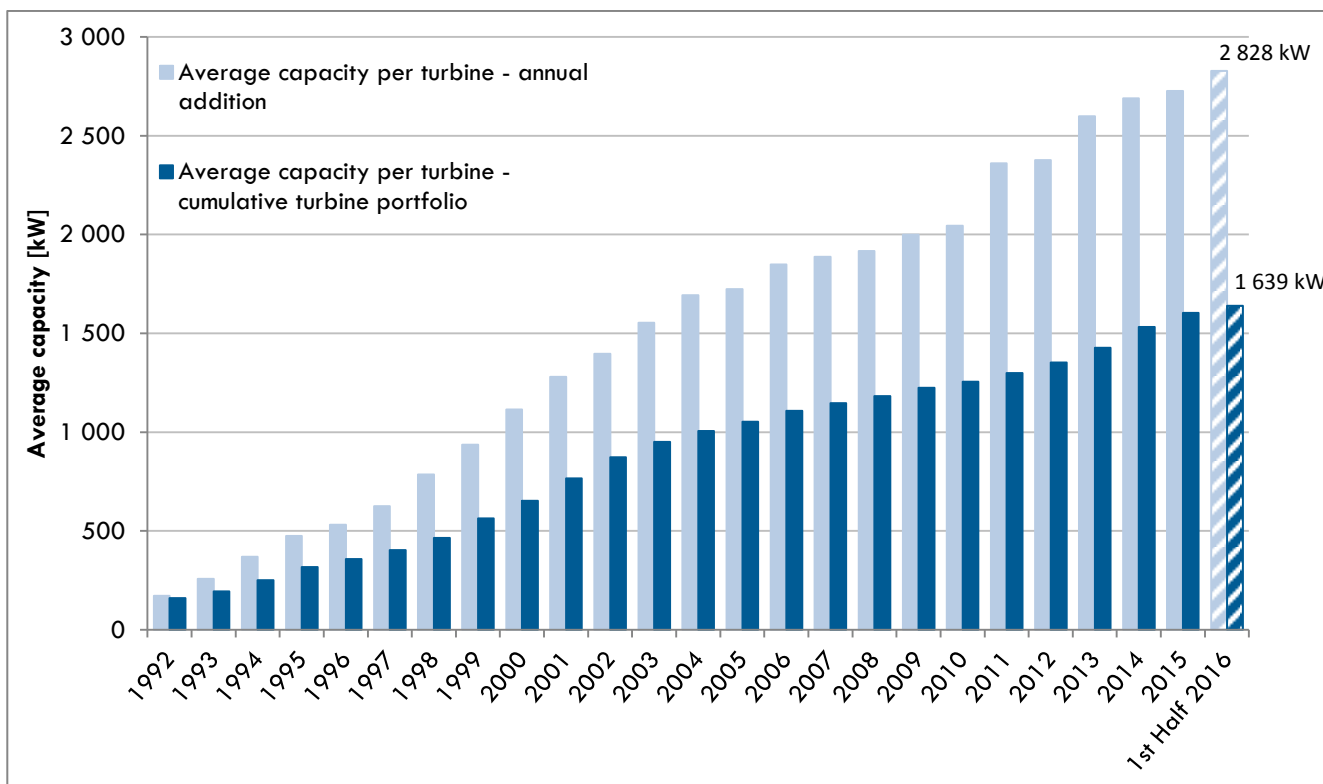


Figure 2: Development of the average capacity of land-based WTGs newly installed and cumulatively present in the German turbine portfolio, Status: 30 June 2016

REGIONAL DISTRIBUTION OF WIND ENERGY DEVELOPMENT

In the first half of 2016, with 421 MW Lower Saxony achieved the largest gross capacity addition and already exceeds the annual addition of 2015 by the end of June. With 322 MW erected in Schleswig-Holstein, the state drops to second place in the comparison after being in the lead for three consecutive years. With a capacity addition of 254 MW in the first half of the year, Brandenburg is ahead of North Rhine-Westphalia with 249 MW. Compared to the previous year, Baden-Wuerttemberg clearly increased its addition to 186 MW and with it reaches fifth place. With 174 MW of added capacity and in sixth place, Bavaria is close behind its neighbour state and with it ahead of Mecklenburg-Western Pomerania, which comes in seventh place with 130 MW.

The northern German states combine 876 MW and thus a share of 42,7% of the gross capacity addition in the first half of 2016. With 727 MW, central Germany holds 35,5% of the share. The southern states add 451 MW of new addition, which is equivalent of 21,8% of the share.

Table 3: Gross addition to wind energy in the German states in the first half of 2016, Status: 30 June 2016

Rank	State	Gross addition in 1 st half of 2016			Average turbine configuration			
		Added capacity [MW]	Added number WTG	Share of added capacity of total addition	Average turbine capacity [kW]	Average rotor diameter [m]	Average hub height [m]	Average specific area capacity [W/m ²]
1	Lower Saxony	421.20	144	20.5%	2 925	109	134	322
2	Schleswig-Holstein	322.25	110	15.7%	2 930	102	98	374
3	Brandenburg	253.70	92	12.4%	2 758	110	134	300
4	North Rhine-Westphalia	248.90	92	12.1%	2 705	103	129	335
5	Baden-Württemberg	185.80	67	9.0%	2 773	119	141	249
6	Bavaria	174.40	65	8.5%	2 683	114	140	264
7	Mecklenburg-Western Pomerania	129.75	42	6.3%	3 089	108	131	338
8	Saxony-Anhalt	91.80	35	4.5%	2 623	101	119	328
9	Hesse	90.40	32	4.4%	2 825	117	139	264
10	Rhineland-Palatinate	71.35	26	3.5%	2 744	114	137	276
11	Thuringia	42.00	14	2.0%	3 000	112	134	304
12	Saarland	16.50	5	0.8%	3 300	126	137	265
13	Bremen	3.00	1	0.1%	3 000	115	149	289
14	Saxony	2.35	1	0.1%	2 350	92	98	354
15	Hamburg	0.00	0	0.0%	-	-	-	-
15	Berlin	0.00	0	0.0%	-	-	-	-
	Total	2 053.40	726	100.0%	2 828	109	129	313

In the first half of 2016, WTG with the highest average capacity of 3 300 kW were erected in Saarland, those with the lowest of 2 350 kW in Saxony. Those states with the comparatively lowest numbers of new WTG's also had the largest and smallest, respectively, average rotor diameters. It was 126 m in Saarland and 92 m in Saxony. The average hub height of 98 m in Schleswig-Holstein and Saxony is the lowest. The WTG installed in Bremen has the largest hub height of 149 m. With 249 W/m², WTG installed in Baden-Wuerttemberg on average have the lowest specific area capacity. WTG in Schleswig-Holstein on average have the largest specific area capacity with 373 W/m².

REGIONAL DISTRIBUTION OF THE CUMULATIVE PORTFOLIO OF WIND TURBINES

The cumulative capacity and number of turbines according to the German states can be ascertained from Table 4. With 5.783 WTG and a total capacity of 8 957 MW, Lower Saxony contributes the largest share of the installed capacity in Germany. Schleswig-Holstein follows in second place with 6 149 MW. With 6 099 MW Brandenburg is the land-locked state with the largest share of the cumulatively installed capacity and compared federally in third place.

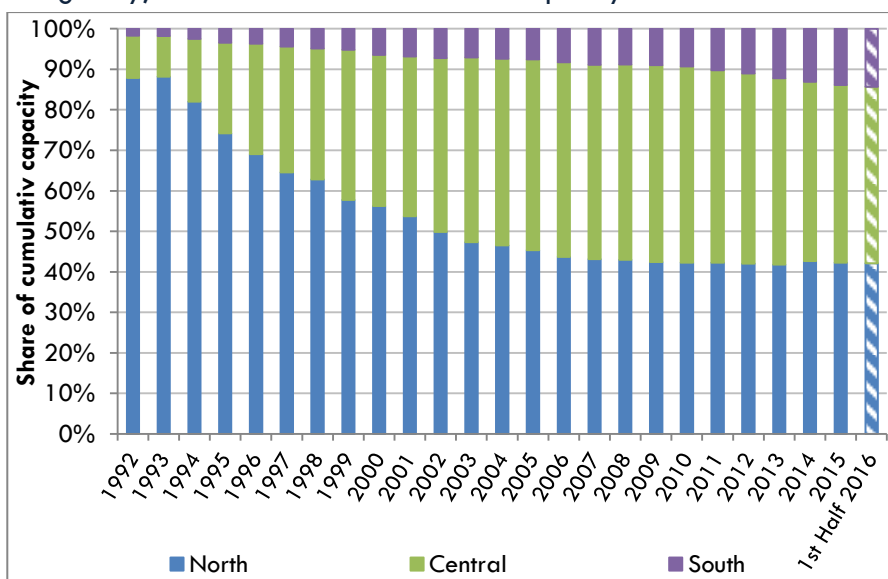
Combined at the end of the first half of 2016, the northern states comprise 42%

of the cumulative capacity. The share of central German states is 44%. 14% of the countrywide installed capacity is found in the southern states. Compared to the previous year, the distribution of the cumulative capacity has barely changed. The share of the northern and central states decreased marginally, while the share of installed capacity in the southern states increased slightly. This constitutes

a continuation of the development as seen in previous years. Figure 3 shows the distribution of the cumulative capacity across the regions over time.

Table 4: Cumulative capacity and number of turbines in the German states, Status: 30 June 2016

Region / State		Cumulative capacity [MW] Status: 30 June 2016	Cumulative number Status: 30 June 2016
North	Lower Saxony	8.957	5.783
	Schleswig-Holstein	6.149	3.498
	Mecklenburg-Western Pomerania	3.006	1.819
	Bremen	174	85
	Hamburg	62	53
Central	Brandenburg	6.099	3.551
	Saxony-Anhalt	4.689	2.731
	North Rhine-Westphalia	4.319	3.256
	Hesse	1.477	918
	Thuringia	1.242	763
	Saxony	1.134	881
	Berlin	9	4
South	Rhineland-Palatinate	2.997	1.561
	Bavaria	2.067	1.002
	Baden-Württemberg	880	515
	Saarland	283	141
		43.544	26.561



Data Collection and Preparation:
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Figure 3: Distribution of the Germany-wide installed cumulative capacity across the regions, Status: 30 June 2016